

**PM Formalisation of  
Micro Food Processing Enterprises (PM-FME) Scheme**

**MODEL DETAILED PROJECT REPORT  
PROCESSING OF JACKFRUIT CHIPS**



**AATMANIRBHAR BHARAT**

**Indian Institute of Food Processing Technology**

Ministry of food processing industries, Government of India

Pudukkottai Road, Thanjavur

Tamil Nadu

## Table of Contents

	Page
<b>1. The Project At a Glance</b>	<b>1</b>
<b>2. General Overview of Production, Post Harvest Management and Value Addition of Jackfruit in India</b>	
2.1. Introduction	2
2.2. Origin and Distribution of Jackfruit	3
2.3. Production of Jackfruit in India	6
2.4. Composition and Nutritional Value of Jackfruit	8
2.5. Health Benefits of Jackfruit	9
2.6. Jackfruit Varieties in India	13
2.7. Cultivation and Harvesting of Jackfruit	15
2.8. Post Harvest Operations, Processing and Storage of Jackfruit	20
<b>3. Model Jackfruit chips Processing Unit under FME Scheme</b>	
3.1. Introduction	23
3.2. Form of the Business Enterprise	23
3.3. Background of the Promoters/Owners and Required Documents	23
3.4. Background of the Proposed Project	24
3.5. Location of the Proposed Project and Land	24
3.6. Installed Capacity	24
3.7. Raw Material Requirements for the Unit	25
3.8. Product Profile of the Unit	25
3.9. Manufacturing Process of Jackfruit chips	26
3.10. Technology Accessibility	26
3.11. Market Demand and Supply	26
3.12. Marketing Strategy	27
3.13. Detailed Project Assumptions	27
3.14. Fixed Capital Investment	
3.14.A. Land & Building	28
3.14.B. Machinery & Equipment	29
3.14.C. Utilities and Fittings	29
3.14.D. Other Fixed Assets	29
3.14.E. Pre-operative Expenses	30
3.14.F. Total Fixed Capital Investment	30
3.15. Working Capital Requirement	30
3.16. Total Project Cost and Means of Finance	31
3.17. Manpower Requirement	31
3.18. Expenditure, Revenue and Profitability Analysis	32
3.19. Repayment Schedule	34
3.20. Assets' Depreciation	35
3.21. Financial Assessment of the Project	36
3.22. Plant Layout	39
3.23. Machinery Suppliers	39
<b>4. Limitations of the Model DPR and Guidelines for Entrepreneurs</b>	
4.1. Limitations of the Model DPR	41
4.2. Guidelines for the Entrepreneurs	41

## CHAPTER 1: THE PROJECT AT A GLANCE

1. Name of the proposed project	:	Jackfruit chips Processing Unit
2. Name of the entrepreneur/ FPO/ SHG/ Cooperative	:	
3. Nature of proposed project :	:	Proprietorship/Company/Partnership
4. Registered office	:	
5. Project site/location	:	
6. Names of Partners (if partnership)	:	
7. No. of share holders (if company/FPC)	:	
8. Technical advisor	:	
9. Marketing advisor/partners	:	
10. Proposed project capacity	:	100 MT/ annum (70%, 80% & 90% capacity utilization in the 2 <sup>nd</sup> , 3 <sup>rd</sup> & 4 <sup>th</sup> years respectively)
11. Raw materials	:	Jackfruit
12. Major product outputs	:	Jackfruit chips
13. Total Project Cost	:	Rs. 37.14 Lakhs
• Land development, building & civil construction(only for expansion of existing built-up area)	:	Rs 2.00 Lakhs
• Machinery and equipments	:	Rs 20.00 Lakhs
• Utilities (Power & water facilities)	:	Rs 2.00 Lakhs
• Miscellaneous fixed assets	:	Rs 2.00 Lakhs
• Pre-operative expenses	:	Rs 0.25 Lakhs
• Contingencies	:	Rs 2.00 Lakhs
• Working capital margin	:	Rs 8.89 Lakhs
14. Working capital requirement		
• 2 nd year	:	Rs 26.66 Lakhs
• 3 rd year	:	Rs 32.17 Lakhs
• 4 th year	:	Rs 36.18 Lakhs
15. Means of Finance		
• Subsidy grant by MoFPI (max 10 lakhs)	:	Rs 10.00 Lakhs
• Promoter's contribution (min 20%)	:	Rs 13.14 Lakhs
• Term loan (42%)	:	Rs 14.00 Lakhs
16. Debt-equity ratio	:	1.07:1
17. Profit after Depreciation, Interest & Tax		
• 2 nd year	:	Rs 16.56 Lakhs
• 3 rd year	:	Rs 37.94 Lakhs
• 4 th year	:	Rs 43.68 Lakhs
18. Average DSCR	:	10.53
19. Benefit-Cost Ratio	:	1.16
20. Term loan repayment	:	7 years with 1year grace period
21. Payback period for investment	:	3 years

## CHAPTER 2

### General Overview of Production, Post Harvest Management and Value Addition of Jackfruit in India

#### 2.1 Introduction

India is the second biggest producer of the Jackfruit in the world and is considered as the motherland of jackfruit. According to some, Chakka, its Malayalam name, has given birth to the English name jackfruit. In India, the total area under jackfruit cultivation is approximately 1,02,552 hectares, of which, an estimated 1,00,000 trees are grown in back yards and as intercrop in other commercial crops (betel nut, coffee, pepper and cardamom plantations) in south India. In India, it has wide distribution in Assam, Tripura, Bihar, Uttar Pradesh, the foothills of the Himalayas and South Indian States of Kerala, Tamil Nadu and Karnataka.

In our country, the trees are found distributed in southern states like Kerala, Tamil Nadu, Karnataka, Goa, coastal Maharashtra and other states like, Assam, Bihar, Tripura, Uttar Pradesh and foothills of Himalayas.

The jackfruit is still an underdog in the Indian scenario. The fruit is perishable and cannot be stored for long time because of its inherent compositional and textural characteristics. In every year, a considerable amount of jackfruit, specially obtained in the glut season (June-July) goes waste due to lack of proper postharvest knowledge during harvesting, transporting and storing both in quality and quantity. It is reported that almost Rs 2,000 crore value of Jackfruit goes to waste annually in the country. According to some resources, Kerala state wastes approximately 35 crore jackfruits every year.

Value addition is still a new concept and the market penetration of value added products is not much due to lack of awareness and handling difficulties. An assessment of the market scenario shows that the demand is more in the northern, southern and western parts of the country and there is also a substantial scope in the export market especially to UK, Middle East and the USA.

The potential for value added products provides an extremely viable opportunity for sustainable promotion of rural as well as urban livelihoods. Processing of jackfruits into various value added products at small scale/ village level and selling to the markets directly/ tying up with big aggregators will help both the farmers and the consumers.

Proper post harvest technology for prolonging shelf life is, therefore, necessary.

Besides, alternate ways of using jackfruits in on-season plays significant roles in reducing postharvest losses. Among them, processing is important one. It adds diversified and attractive food items in dietary menu as well as contributes to generation of income and employment.

Therefore, processing of Jackfruit into various value added products such as Jackfruit chips can ensure nutritional and food security, improved profitability and also offers huge scope for entrepreneurship development at micro, small or medium scale levels using effective government schemes such as PM-Formalization of Micro Food Processing Enterprises Scheme of MoFPI, Government of India.

## **2.2 Origin and distribution of Jackfruit**

Jackfruit is a tropical fruit species found in tropical, high rainfall, coastal and humid areas of the world. It belongs to family Moraceae. Scientifically known as *Artocarpus heterophyllus*, it is the favourite fruit of many owing to its sweetness.

This family encompasses about 1,000 species in 67 genera, mostly tropical shrubs and trees, but also a few vines and herbs. The word *Artocarpus* is derived from the Greek words *artos* (bread) and *carpos* (fruit). The name “Jackfruit” is derived from the Portuguese *jaca*, which in turn, is derived from the Malayalam language term, *chakka*. The fruit is popularly known as, *kathal* or *kata-hai* in Bengali and in Hindi. The Malayalam name *chakka* was recorded by Hendrikl van Rheede (1678-1703) in the *Hortus Malabaricus*, vol. iii in Latin.

Jackfruit does not spread readily and is not considered invasive species. In most areas of the world where jackfruit is grown, its presence is indicative of human cultivation. Jackfruit was introduced to most Pacific Islands, mainly in home gardens, where it finds a place among other favourite multipurpose plants. It is easy to grow and more adaptable than some of the other common *Artocarpus* species like the breadfruit (*A. altilis*).

All parts of the tree have been reported to have medicinal properties. The Chinese consider jackfruit pulp and seeds as tonic, cooling and nutritious, and to be useful in overcoming the influence of alcohol on the system. The seed starch is given to a person to relieve biliousness and the roasted seeds are regarded as aphrodisiac. The ash of jackfruit leaves if mixed with corn and coconut shell ash is used alone or mixed with coconut oil to heal ulcers. The dried latex yields artostenone, a compound that is convertible to artosterone, which has a potent androgenic property. If mixed with vinegar, the latex promotes healing of abscesses. The root is a remedy

for skin diseases and asthma. An extract of the root is taken and used as cure for fever and diarrhoea. The bark is made into poultices. Heated leaves are placed on wounds. The wood has a sedative property; its pith is reported to induce abortion. Aside from flavouring for beverages, the fruit can be fermented and distilled to produce alcoholic liquor.

**Table 1: Different jackfruit cultivars in the world**

Country	Cultivars/varieties	Distinguishing characters
Sri Lanka	Father Long	Oblong, large size fruits (10-15 kg), perianth is attractive dark yellow colour, thick crispy and sweet in taste
	Maharagama	Oblong, large size fruits (10-15 kg), perianth is yellowish orange, crispy and sweet
	Kothmale	Oblong, large fruits (10-15 kg), large perianth, yellowish orange, crispy and sweet
	Hirosa (Rosa Kos)	Oblong, large fruit, large perianth, yellowish orange, crispy and sweet
	Mandoor	Round medium size fruit (8-10 kg), large perianth, dark yellow colour, crispy and sweet
Indonesia	Nangkamerah	Red orange ( <i>merah</i> ) colour
	Nangkasalak	Thick fruit flesh, soft, strong flavour, fruit flesh is similar to salacca fruit
	Nangka durian	Fruit flesh is similar to durian
	Nangkacempedak	Thin flesh fruit, having good and specific flavor
	Nangkaburbur	Thin fruit flesh, soft, strong flavor
	Red nangka mini/ round nangka mini	Mini jackfruit
	Nangkakunir	Officially released as a national superior variety
	Tabouey	Fruit round, flesh yellow, firm, pleasant flavor and very little aroma
Philippines	<i>Sinapelo</i>	Fruit is oblong, average fruit weight 10 kg, flesh is yellow orange, firm and very sweet
	<i>Cervantes Gold</i>	Fruit is ellipsoid, average fruit weight 10 kg, flesh is golden yellow, sweet, crispy with strong aroma
	<i>EVIARC Sweet</i>	Fruit is ovoid, average fruit weight 12 kg, flesh is golden yellow, sweet (25 °B), crispy with strong aroma

	<i>MMSU SRO</i>	Fruit is ellipsoid, average fruit weight 8 kg, flesh is yellow orange, very sweet (30°B), firm with mild aroma
	<i>Mabini</i>	Fruit is oblong, average fruit weight 15 kg, flesh is yellow orange, sweet (20.4 °B) with strong aroma
Malaysia	J2	Flesh taste sweet with a ting of acid and is slightly fibrous, moderate aroma and poor shelf life
	J27	Medium size fruit, thick fleshed, orange in colour, sweet taste
	J28	Thick flesh, golden yellow in colour, sweet taste
	J29	Medium to large fruit, round in shape, pulp yellow, thick, sweet and good for fresh consumption
	J30	Elongate fruit, flesh yellow, thick, sweet with a moderate aroma
	J31	Yellow flesh, medium thick, crispy, sweet, strong aroma with fine texture, dual purpose, suitable for canning
	Black Gold	Pulp deep orange, soft, sweet and aromatic
	Cheena	Pulp deep orange, soft, excellent quality and very aromatic
	Cochin	Pulp yellow to orange, firm, quality good and mild aroma
	Chompa Gob	Flaks orange, firm, mild flavour
	Golden Nugget	Flaks deep orange, soft to medium firm, excellent flavour
	Lemon Gold	Flaks lemon yellow, firm, sweet and aromatic flavor
Bangladesh	Topa, Hazari, Chala, Goal, Koa, Khaja	
Myanmar	Talaing, Kala	

Jackfruit plays a significant role in Indian agriculture and culture. It was cultivated in India 3,000- 6,000 years ago. Jackfruit is widely grown as an important tree in Kerala's homesteads and also as a shade crop in coffee plantations. It is popularly known as poor man's fruit in the eastern and southern parts of India. The tender fruits of the tree are used as vegetables and the ripe ones as table fruits.

### **2.3 Production of Jackfruit in India**

The benefit of cultivation of the jackfruit depends upon whether it is grown in the homestead as a backyard crop or as a plantation crop. Establishment of a jackfruit plantation requires a large investment such as the nursery establishment, proper management of the crop, etc. However, during the first 3-4 years, other crops such as pineapple or vegetables can be grown which will cover the cost of maintaining the jackfruit plants.

The traditional varieties bear fruits once in a year. Usually, the flowering starts from mid-November and extends till mid-February, depending on the location and the variety. The tender fruits come to market from March onwards and continue till August. The fruits begin to ripe in the month of June. However, the late varieties may ripen in October. Fresh and tender fruits are usually not available from November onwards.

Commercial cultivation of jackfruit is still at a primitive stage in India, primarily because of the difficulty in procuring elite planting materials. Jack is easily propagated through seeds. The seedlings take 8-10 years to bear fruits. Due to the highly cross pollinated nature of the crop, vegetative propagation is essential in order to get true to type plants.

Since jackfruit is very bulky and perishable, processing can reduce transport costs, prevent spoilage, increase shelf life. Processed products usually command higher prices especially during the off-peak season. If the farmers can form cooperatives and arrange cold storage facilities, they can increase their profits by storing the produce during the peak season and then sell the fruits during the off-peak season.

#### **2.3.1 Production status of Jackfruit**

Major jackfruit producers are Bangladesh, India, Myanmar, Thailand, Vietnam, China, the Philippines, Indonesia, Malaysia and Sri Lanka.



**Table 2: Area, production and productivity of jackfruit in Asia**

Country	Area ('000 ha)	Production ('000 t)	Productivity (t/ha)
Bangladesh	10.00 (2006)	926.00	8.20
India	102.00 (1992)	1436.00	11.40
Indonesia	50.00 (1987)	340.00	9.00
Malaysia	5.00 (1987)	13.00	10.00
Nepal	1.60 (2009-10)	18.97	11.89
	2.17 (2002-03)	17.16	11.60
Sri Lanka	50.00 (2011)	*	*
Thailand	37.00 (1987)	392.00	10.00

### 2.3.2 Production and yield of Jackfruit in major states in India

India is the second biggest producer of the fruit in the world and is considered as the motherland of jackfruit. Chakka, its Malayalam name, according to some, has given birth to the English name jackfruit.

In India, the total area under jackfruit cultivation is approximately 1,02,552 hectares, of which, an estimated 1,00,000 trees are grown in back yards and as intercrop in other commercial crops (betel nut, coffee, pepper and cardamom plantations) in south India. In India, it has wide distribution in Assam, Tripura, Bihar, Uttar Pradesh, the foothills of the Himalayas and South Indian States of Kerala, Tamil Nadu and Karnataka.

In India, the major area under jackfruit is in Kerala state and it was regarded as heavenly fruit in the ancient periods. It is grown in an area of 97,536 ha with annual production of 348 million fruits and productivity of 3,568 fruits per ha. The region comprising Assam and Tripura produces major share of jackfruit in India and the total annual production in Assam is estimated to be in the vicinity of 1,75,000 tons. In Assam, though the area and production has not shown any change, but the productivity has been improving. The value of jackfruit in Karnataka has been calculated at Rs.12,718 lakhs.

**Table 3: Area, production and productivity of jackfruit in Indian states**

States	Area (000' ha)	Production (000' MT)	Productivity (t/ha)	Year
Arunachal Pradesh	1.06	8.52	8.03	2005
Jharkhand	4.10	41.00	10.01	2008
Karnataka	6.78	231.57	34.17	2005
West Bengal	10.42	143.47	13.76	2005
Kerala	97.54	348	9.49	2010
Assam	18.00			2003-04

Source: Horticultural Crop statistics

## 2.4 Composition and Nutritional value of Jackfruit

**Table 4: Composition of jackfruit (100 g edible portion), fresh weight basis**

Nutrients	Young fruit	Ripe fruit	Seed
Water (g)	76.2-85.2	72.0-94.0	51.0-64.5
Protein (g)	2.0-2.6	1.2-1.9	6.6-7.04
Fat (g)	0.1-0.6	0.1-0.4	0.40-0.43
Carbohydrate (g)	9.4-11.5	16.0-25.4	25.8-38.4
Fibre (g)	2.6-3.6	1.0-1.5	1.0-1.5
Total sugars (g)		20.6	
Total minerals (g)	0.9	0.8-0.9	0.9-1.2
Calcium (mg)	30.0-73.2	20.0-37.0	50.0
Magnesium (mg)	NA*	27.0	54.0
Phosphorus (mg)	20.0-57.2	38.0-41.0	38.0-97.0
Potassium (mg)	287.0-323.0	191.0-407.0	246.0
Sodium (mg)	3.0-35.0	2.0-41.0	63.2
Iron (mg)	0.4-1.9	0.5-1.1	1.5
Vitamin A (IU)	30.0	175.0-540.0	10.0-17.0
Thiamine (mg)	0.05-0.15	0.03-0.09	0.25
Riboflavin (mg)	0.05-0.2	0.05-0.4	0.11-0.3
Vitamin C (mg)	12.0-14.0	7.0-10.0	11.0
Energy (kJ)	50-210	88-410	133-139

**Table 5: Nutritive value jackfruit (per 100 g)**

<b>Nutrients</b>	<b>Nutrient value</b>	<b>RDA (%)</b>
Cholesterol (mg)	0	0
Dietary fiber (g)	1.5	4.0
<b>Vitamins</b>		
Folate ( $\mu\text{g}$ )	24.0	6.0
Niacin (mg)	0.920	6.0
Pyridoxine (mg)	0.329	25.0
Riboflavin (mg)	0.055	4.0
Thiamin (mg)	0.105	9.0
Vitamin A (IU)	110.0	3.5
Vitamin C (mg)	13.7	23.0
Vitamin E (mg)	0.34	2.0
<b>Electrolytes</b>		
Sodium (mg)	3.0	0
Potassium (mg)	303.0	6.5
<b>Minerals</b>		
Calcium (mg)	34.0	3.4
Iron (mg)	0.60	7.5
Magnesium (mg)	37.0	9.0
Manganese (mg)	0.197	8.5
Phosphorus (mg)	36.0	5.0
Phosphorus (mg)	21.0	3.0
Selenium (mg)	0.6	1.0
Zinc (mg)	0.42	4.0
<b>Phytonutrients</b>		
Carotene- $\beta$ ( $\mu\text{g}$ )	61.0	*
Crypto-xanthin- $\beta$ ( $\mu\text{g}$ )	5.0	*
Lutein-zeaxanthin ( $\mu\text{g}$ )	157.0	*

Source: USDA National Nutrient Database

\*No Recommended RDA for phytonutrients

## 2.5 Health benefits of Jackfruit

- **Strengthens Immune System**

Jackfruit is an excellent source of vitamin C, which helps to protect against viral and bacterial infections. Vitamin C helps to strengthen the immune system function by supporting the white blood cells function. One cup of jackfruit can supply the body with a very good amount of this powerful antioxidant.

- **Protects against Cancer**

In addition to containing vitamin C, jackfruit is also rich in phyto-nutrients such as lignants, isoflavones and saponin which have anti cancer and anti aging properties. These phyto-nutrients may help eliminate cancer causing free radicals from the body and slow the degeneration of cells that can lead to degenerative diseases

- **Aids in healthy digestion**

Jackfruit is also known to contain anti ulcer properties which help cure ulcers and digestive disorders. In addition, the presence of high fiber in the jackfruit prevents constipation and helps in smooth bowel movements. These fibers also offer protection to mucous membrane by driving away the carcinogenic chemicals from the large intestine.

- **Maintains healthy eye and skin**

Jackfruit contains vitamin A, a powerful nutrient which is known to maintain a healthy eye and skin. It also helps prevent vision related problems such as macular degeneration and night blindness

- **Boosts Energy**

Jackfruit is considered as an energy generating fruit due to the presence of simple sugars like fructose and sucrose which give an immediate energy boost. Although Jackfruit is an energy rich fruit it contains no saturated fatty oil and cholesterol making it a healthy fruit to savour.

- **Lowers blood pressure**

Potassium contained in Jackfruit has been found to be helpful in the lowering of blood pressure and thus reducing the risk of heart attack as well as strokes.

- **Controls Asthma**

The root of jackfruit has been found to help those who suffer from asthma. Extract of boiled jackfruit root has been found to control asthma

- **Strengthens bones**

Jackfruit is rich in magnesium a nutrient which is important in the absorption of calcium and works with calcium to help strengthen the bone and prevent bone related disorders such as osteoporosis

- **Prevents Anemia**

Jackfruit also contains iron which helps to prevent anaemia and also helps in proper blood circulation in our body

- **Maintains Thyroid health**

Jackfruit is loaded with Copper, an important mineral, which plays a key role in the thyroid metabolism, especially in hormone production and absorption.

### **2.5.1. Nutraceutical properties of Jackfruit**

- **Anticancer properties**

Phytonutrients in jackfruit bulbs have anticancer properties. The main role of these nutrients is to help prevent the harmful free radicals that have been known to develop cancer and many other chronic diseases. The phytonutrients prevent the very initial stage of cancer cell formation. Saponins are also strong anticancer agents. Saponins show colon cancer preventative properties. These phytonutrients have been found to induce mitotic arrest in the case of leukemia cells. The study also found that it helped in some cases to cause remission. Saponins were found to react to the outer layers of cancer cells. They bound the cells and prevented their further growth.

Jackfruit is rich in fiber. It also has a unique sticky form. Both these properties combine together to work as a great colon cleanser. It helps in removing toxins from your digestive tract. This further helps in reducing the risk of colon cancer.

- **Diabetic supportive**

The extract of jackfruit improves the glucose tolerance in normal human subjects and diabetic patients. Jackfruit contains vitamin A, vitamin C, thiamin, riboflavin, niacin, calcium, potassium, iron, manganese and magnesium among many other nutrients. It is good for diabetes as they improve insulin resistance.

Consuming 100g of the jack fruit meal per day for 4 months leads to quantitative reduction in fasting blood glucose (FBG), postprandial blood glucose (PBG), and hemoglobin A1c (HbA1c) compared with the baseline. The HbA1c decreased by 13.59%, FBG by 22.68%, and PBG by 25.69%. They have concluded that the dietary supplementation of the jackfruit raw fruit meal preparation has an impact in reducing type 2 diabetes.

Jackfruit has beneficial nutritional parameters and a low GI. This could be due to

the collective contributions of dietary fiber, slowly available glucose, intact starch granules in seeds and influence of different sources of carbohydrates.

- **Immune System supportive**

Jacalin, the major protein from the *Artocarpus heterophyllus* seeds, is a tetrameric two-chain lectin combining a heavy chain of 133 amino acid residues with a light  $\beta$  chain of 20–21 amino acid residues. Jacalin's uniqueness in being strongly mitogenic for human CD4 + T lymphocytes has made it a useful tool for the evaluation of the immune status of patients infected with human immunodeficiency virus HIV-1.

- **Digestion promotive**

The presence of high fiber (3.6 g/ 100 g) in the jackfruit prevents constipation and helps in smooth bowel movements. These fibers also offer protection against colon mucous membrane by removing or driving away the carcinogenic.

- **Cardiovascular supportive**

One of the major risk factors for the development of coronary heart disease is dyslipidemia, which is mainly characterized by elevated levels of low-density lipoprotein cholesterol (LDL-C) and/ or reduced high-density lipoprotein cholesterol (HDL-C). Jackfruit seeds may help reduce levels of low-density lipoprotein (LDL) cholesterol and raise levels of high-density lipoprotein (HDL) cholesterol.

- **Fast-Dissolving Tablets**

The major storage carbohydrate in plants is starch. The annual world-wide production of starch is 66.5 million tons (FAOSTAT). Growing demand for starches in the industry has created interest in new sources of this polysaccharide, such as leaves, legume seeds, and fruits. It has immense industrial use in the manufacture of products such as food, textile, paper, adhesives, and pharmaceuticals. Starch can also serve as a thickening, gelling, and film-forming properties.

Jackfruit seed cotyledons are fairly rich in starch and protein. The recent investigation shows that the jackfruit seed starch has potential in pharmaceutical industries. The starches extracted from jackfruit seeds are used as super disintegrants for the formulation of fast-dissolving tablets (FDT).

- **Antimicrobial properties**

Jackfruit is well known to have antibacterial property against 24 species of bacteria. A jackfruit lectin, i.e., jacalin, inhibits DNA viruses such as herpes simplex virus type

II (HSV-2), varicella-zoster virus (VZV), and cytomegalovirus (CMV) The jackfruit could be considered a functional food because it has valuable compounds in different parts of the fruit that display functional and medicinal effects.

- **Functional foods**

'Functional foods' are those that provide more than simple nutrition; they supply additional physiological benefits to the consumer. Because dietary habits are specific to populations and vary widely, it is necessary to study the disease-preventive potential of functional micronutrients in the regional diets.

- **Dental Health promotive**

In jackfruit tree, latex or resin are found on the trunk of tree as well as the fruit. All parts of jackfruit tree contain sticky white latex which produced from special secretory cells called laticifers. Latex is an aqueous emulsion containing many ingredients, for instance, lipids, rubbers, resins, sugars, and proteins including proteolytic enzymes

The jackfruit latex extract which is rich in flavonoids and alkaloids was checked for antibacterial and antifungal properties which shows fairly well and significant comparison with standard antibacterial and antifungal drugs. They concluded that this information gives about the several important uses of jackfruit latex or resin, or both can be utilized as the cementing medium, irrigation solution (washing of a body cavity or wound by a stream of fluid), denture cleaning solution, resin, and other future dental filling material in terms of cost-effectiveness.

## **2.6 Jackfruit Varieties in India**

In the northern India, so far, there is no well-defined variety in jackfruit and different types are known differently in different localities. Local selections have been named as Gulabi (rose scented), Champa (flavour like that of *Michelia* sp.), Hazari (bearing more number of fruits in a tree). In Uttar Pradesh (U.P.), a small fruited (2-8 kg) jackfruit variety known as Barka and a large fruited variety Kapa are grown. The Kapa variety locally known as Kathal in U.P. produces fruits as big as 40 kg in weight and the fruit is very sweet in taste on ripening.

In South India (Kerala, Tamil Nadu and Karnataka), different forms of jackfruit (Varikka, Koozha, Navarikka) are available. Jackfruit having firm flesh is called Varikka; this is more important commercially and possesses crispy carpels/ flakes of

high quality. On the other hand, jackfruit with soft flesh is called Koozha. They have small fruits whose flesh is fibrous, soft, mushy, but it has very sweet carpels/flakes. The fruit of the Koozha variety is consumed mainly in the raw stage like preparing pickles or cooking different vegetable dishes. The fruits of the Koozha variety if allowed to ripen, do not taste as good as the Varikka variety because the flesh is soft or soggy. In contrast, the Varikka variety is used both in the raw (unripe) and ripe stages. If used in the unripe stage, it is usually made into curries and deep-fried chips. The Varikka types are preferred for canning in the processing industries.

In the Western Ghats, a variety Muttam Varikka producing fruits weighing 7 kg each (46 cm long x 23 cm wide) is popular. The pulp is crisp, fleshy, nonfibrous, golden yellow and has very good edible quality.

The Tamil Nadu Agricultural University (TNAU), Coimbatore (India) has developed two improved varieties, viz., Palur-1 and PPI Jack which have shown good performance in the state. A jackfruit variety known as Singapore or Ceylon Jack, introduced from Sri Lanka is a popular variety. Ceylon Jack variety produces fruits from 3rd year of planting and fruit weighs 5-20 kg. Certain other varieties named as Velipala, Hybrid Jack, Panruti Selection and Burliar I are also popular in different localities.

**Table 6: Varieties in India**

State	Cultivars/varieties	Distinguishing characters
Kerala	Muttom Varikka	Firm fleshed, sweet scented variety
	Singapore jack or Ceylon jack	High yielding early bearing variety, a tree many yield as many as 250 fruits
	Sindhoor	Highly sweet variety with attract sunset orange coloured flakes, bear medium sized fruits (11-12 kg) twice a year
Tamil Nadu	T Nagar Jack	Large fruits with good quality
	Palur jack or PLR -1	Average fruit weight of 12 kg with 115-120 flakes, off season fruiting, TSS 19°B, golden yellow firm flakes
	PPI Jack	Average fruit weight of 17 kg, fruit bearing occurs twice in an year, flakes are sweet and tasty with pleasant aroma suitable for commercial planting and home gardens



	PLR (J) - 2	Average fruit weight of 16-19 kg, edible flakes fetches more price due to attractive characters and good keeping quality
	Burliar-1	Flakes thick, crisp, juicy with golden yellow colour
Uttar Pradesh	NJC 1, NJC 2, NJC 3	Small to medium size fruit with thin rind where found to be better for culinary purpose
	NJT 1, NJT 2, NJT 3, NJT 4	Large fruit and excellent pulp quality, have been identified for table purpose
Karnataka	Swarna	Medium sized fruit 6-8 kg, fruit colour golden brown, TSS 25-26 °B
	Gumless type (Pre- released)	Medium to low latex is the specialty, average fruit weight 6.4 -9 kg, flakes colour light yellow, sweet in taste having TSS 26 -30 °B
	Kachehalli jackfruit (GI status)	Fruits are ellipsoid/elongate shaped, weighed 20 -25 kg having 300- 350 flakes/fruit, flakes are deep coppery red in colour, TSS of 32 °B
Maharashtra	Konkan prolific	Average fruit weight 5.7 kg, flakes colour golden yellow, TSS 25 °B

## 2.7 Cultivation and Harvesting of Jackfruit

### 2.7.1 Climatic and soil requirements

Jack grows well and gives good yield in warm humid climate of hill slopes and hot humid climate of plains. The crop grows successfully from sea level upto an elevation of 1200m at an optimum temperature range of 22-35°C. It cannot tolerate frost or drought. The yield and quality of fruits are medium under low humidity. The West coast plains with high humidity are found to be highly suitable.

The jackfruit tree flourishes in rich, deep soil of medium or open texture, sometimes on deep gravelly or laterite soil. It will grow, but more slowly and not as tall in shallow limestone. In India, they say that the tree grows tall and thin on sand, short and thick on stony land. It cannot tolerate "wet feet". If the roots touch water, the tree will not bear fruit or may die. A deep rich alluvial or open textured loamy soil or red laterite soils with slightly acidic condition (pH 6.0 – 6.5) with good drainage is ideal for jack

fruit, however, it can come up in variety of soils.

### 2.7.2. Propagation and planting

Commercial cultivation of jackfruit is still at a primitive stage in India, primarily because of the difficulty in procuring elite planting materials. Jack is easily propagated through seeds. The seedlings take 8-10 years to bear fruits. Due to the highly cross pollinated nature of the crop, vegetative propagation is essential in order to get true to type plants.

Propagation is usually by seeds which can be kept no longer than a month before planting. Germination requires 3 to 8 weeks but is expedited by soaking seeds in water for 24 hours. Soaking the seeds in a 10% solution of gibberellic acid results in 100% germination. The seeds may be sown *in situ* or may be nursery-germinated and moved when no more than 4 leaves have appeared. A more advanced seedling, with its long and delicate tap root, is very difficult to transplant successfully.

When propagated through seeds, jack exhibits a wide variation among its progenies. Hence vegetative propagation is recommended. Commercially inarching on 10 months old jack seedlings is done to produce vegetative progenies. The grafts come to bearing within 4½- 5 years when compared to seedlings which take 7-8 years normally.

Soaking one-month-old seedlings in a gibberellic acid solution (25– 200 ppm) enhances shoot growth. Gibberellic acid spray and paste increase root growth.

Soft wood grafting (cleft method) on 2 months old seedlings with scion of 3-4 months old also was found to be successful (70 -80%). Since the viability of seeds is very low, seeds have to be sown immediately after extraction to raise rootstocks. Rudrakshi and *A. hirsuta* are also used as rootstock.

Pits of size 1 cubic meter are dug at a spacing of 6-8 m and filled with top soil mixed with 10 kg FYM. The grafts are planted in the centre of the pits during June-September. Proper staking is required to avoid lodging and subsequent breakage at graft joint. Thatching or providing shade with coconut leaves and thorough mulching of basins after the cessation of monsoon season are essential to avoid mortality of grafts.

In plantations, the trees are set 30 to 40 ft (9-12 m) apart. Young plantings require protection from sunscald and from grazing animals, hares, deer, etc. Seeds in the

field may be eaten by rats. In areas of Travancore, the whole fruit is buried, the many seedlings which spring up are bound together with straw and they gradually fuse into one tree which bears in 6 to 7 years.

Seedlings may ordinarily take 4 to 14 years to come into bearing, though certain precocious cultivars may begin to bear in 2 1/2 to 3 1/2 years. The jackfruit is a fairly rapid grower, reaching 58 ft (17.5 m) in height and 28 in (70 cm) around the trunk in 20 years in Ceylon. It is said to live as long as 100 years. However, productivity declines with age. In Thailand alternate rows are planted every 10 years so that 20-year-old trees may be routinely removed from the plantation and replaced by a new generation.

### 2.7.3. Training and manuring

Jack trees are trained to a single stem, early side branches should be removed so that a uniform smooth trunk develops for a height of 1.5- 2 m and then side branches should be permitted to arise. The flower buds appear on trunk which should be kept free of vegetative growth. The nutrients should be applied as detailed below.

Manure/ Nutrients	1 year after planting (Kg/plant)	Annual increase (Kg/plant)	5th year onwards (Kg/plant)
Farm Yard Manure	10 kg	10 kg	50 kg
N	0.150	0.150	0.750
P	0.080	0.080	0.400
K	0.100	0.100	0.500

The fertilizers are applied during rainy season. If irrigation is available they can be split into two doses and applied twice in a year i.e during June - July and September-October. The manures and fertilizers can be applied in a circular trench taken 50-60 cm away from the trunk. Severe symptoms of manganese deficiency have been observed in India.

#### **2.7.4. Irrigation**

Though jack is cultivated under rain-fed conditions, it is very sensitive to drought. Hence irrigation should be done depending on the type of soil, season etc. so that, there should not be any moisture stress especially during flowering and fruit set. Similarly too much of soil moisture will affect the quality of fruit. The carpels will develop an insipid taste when there is excess soil moisture.

#### **2.7.5. Inter-cultivation**

During the pre-bearing age pulses can be raised as intercrop and dried leaves can be spread below the trees to serve as mulch for moisture conservation. As the trunk increases in size, the active buds of female inflorescence develop from the trunk as well as from main scaffold branches, this type of bearing habit is called 'cauliflorus'. These fruit buds should be protected from any possible damage by rubbing of body of the stray cattle such as buffaloes through spreading dried thorny bushes. This is very essential especially when there is no proper fence in the fields.

#### **2.7.6. Harvesting**

Normally jack starts producing fruits from 7th – 8th year onwards. Grafted plants can start yield from 4th to 5th year itself. In Singapore jack, even seedlings start bearing from 3rd year. The tree attains its peak bearing stage in about 15-16 years of planting. At this stage, normally a tree bears up to 250 fruits annually with annual fluctuation in yield. The weight of fruits also varies depending on the type. On an average, about 40-50 tons of fruits per hectare could be obtained.

Fruits mature 3 to 8 months from flowering. Normally the fruits will be available from March to June. Period of fruit development is February to June. In higher elevation harvest extends upto September. Even in plains certain genotypes bear an off season crop during October – December. The optimum stage of maturity (harvest) of jackfruit has been reported to be 90-110 days after the appearance of the spike.

The yield ranges from 20 to 100 fruits / tree. The fruit weight varies from 10 to 30 kg. In India, a good yield is 150 large fruits per tree annually, though some trees bear as many as 250 and a fully mature tree may produce 500, these probably of medium or small size. On an average, 50-80 tons of fruits can be harvested from a hectare of land.

Harvesting is done by cutting off the fruit stalks carrying the fruits. By just looking at the fruit, an experienced farmer can quickly identify the maturity date of the fruit.

The fruits are harvested at different stages of maturity depending on the intended use and market demand. When fruits are used as a vegetable or for preparing pickles, very immature fruits, where fruitlets (bulbs) or seeds are not yet fully formed, are harvested. They are rather dark green with stiff, hard and closely spaced spines.

The testa (exocarp) of the seeds is not yet formed; hence there is no need of removing the testa while preparing them for use as vegetables. The seeds at this stage are still very tender and tasty. In the third stage, fully developed fruitlets and seeds are used for making various preparations like curries. A dull, hollow sound when the fruit is tapped is considered to be the most reliable indicator that the fruit is already mature. Harvesting at this stage permits the fruit to be used for making chips, various curries, etc. If ripe fruits are preferred, they can be also picked at the mature stage when they emit the jackfruit's characteristic aroma.

Therefore, for fruits to be used for processing into chips, criteria for harvesting should be when the spines start to grow further apart, but not yet fully flattened and the skin colour should be still green and the fruit produces a dull, hollow sound when tapped with hand. Since individual trees will have fruits of different maturity levels, it is necessary to harvest the fruits at least weekly. About 60% of the whole jackfruit consists of inedible parts such as outer prickly rind, inner perigones, and central core and only around 35% of the whole fruit consist of edible flesh.

Fruit should be harvested by cutting from the stalk using sharp bladed equipment. If the fruit is high up in the tree, a sack should be tied around the fruit with a rope, the stalk should be cut, and the fruit should be gently lowered to the ground.

It is always best to harvest and handle fruits with care to prevent mechanical injuries that hasten fruit deterioration. During bulk harvesting, sacks filled with rice straw are used to drop the fruits from the tree without damage. While harvesting, the person on the ground will keep on moving the sacks around the tree, while the person on the tree will drop the fruits on the sacks. Alternatively, a person on the ground will be ready with a second sack full of straw so that in case the aim is not good, he will throw the sack on the spot where the fruit is falling. This technique has been proven to be very effective in harvesting jackfruits safely and without damaging them.

## **2.8 Post Harvest Operations, Processing and Storage of Jackfruit**

### **2.8.1 Post harvest operations for Jackfruit**

#### **a. Collecting the harvested Jackfruit**

After harvest, the fruit should be laid for some time with its stalk down to allow the latex to flow and coagulate. The use of dried banana leaves or other cushioning materials placed in between the layers of fruits can minimize mechanical damage during transport. It is also important to prevent the spread of latex on the surface of the fruits so that they look fresh.

#### **b. Transport**

It is usually done in motorized vehicles (trucks and vans). The vehicles must be clean to avoid impurities such as dirt and stones that damage the fruit, thereby endangering the quality and shelf life of the fruit.

Jackfruit, being bulky and highly perishable, has quite high transport costs. Hence processing locally will enable reduced transport costs

#### **c. Storage**

Harvesting of jackfruit in green mature stage can prevent the mechanical damage. Also, adaption to appropriate postharvest practices may facilitate the exportation through extended shelf life. Storage of whole jackfruit at 10°C and 85-90% humidity can extend the shelf life of the crop approximately by two weeks.

### **2.8.2 Processing of Jackfruit Chips**

#### **a. Fruit selection:**

Whole jackfruits of firm variety, with an average weight of 8–10 kg, devoid of any visible microbial infection or mechanical fissures with proper maturity should be selected. A dull, hollow sound when the fruit is tapped is considered to be the most reliable indicator that the fruit is already mature. Varieties with high dry matter content should be selected, as it directly impacts the product quality.

**b. Washing:**

Fully mature jackfruits are taken and washed with clean water properly to remove the external impurities. The fruits' surface can be sanitized with 100 ppm chlorinated water.

**c. Peeling & De-seeding:**

Peeling is then done carefully. The edible perianth portion (bulbs) are separated manually by slitting open the fruit using stainless steel knives. The bulbs are given a vertical cut to remove the seed.

**d. Slicing:**

The pitted bulbs are cut vertically into uniform 4cm X 2 cm slices, manually or using a slicer. Mechanical slicers are preferable; they can minimize loss of material and can do trouble free-slicing at higher quality and better efficiency than manual slicing. The manual labour and drudgery can be eliminated.

The sliced bulbs can be subjected to wash in 30 ppm chlorinated water.

**e. Blanching & draining**

Blanching is done to arrest the enzymatic activities before drying, to reduce glucose concentrations in the slices and lower acrylamide formation during frying. Blanching also significantly impacts the color and oil uptake of the end product positively.

The slices are weighed out and immersed in hot water at 90°C containing 0.1% KMS for 10-15 minutes. For every kg of sliced bulbs, 2 kg of blanching solution is needed. The blanched slices are cooled to room temperature, by immersing in cold water for 15 minutes; this is done to avoid cooking.

**f. Drying:**

After sieving water, the slices are dried using a mechanical dryer in view to absorbing less oil in subsequent frying maintaining temperature 70°C for 1 hour and 60°C for the next 6 hours. Drying has a significant effect on the deep frying. Reducing the food moisture content by drying can reduce oil absorption during frying by up to 54%.

### **g. Frying:**

Frying is a complex operation process where the fruit slices are immersed in hot vegetable oil, at a temperature of above the boiling point of water. The frying process should reduce the initial moisture content of dried slices (75%) to 4%, the ideal moisture content of freshly prepared fried chips.

The slices are fried in edible oil; coconut oil is used in Kerala, while any refined vegetable oil such as sunflower oil can be used. Preferably, the ratio of jackfruit slice to oil should be 1:2.5 to 1:4.

The dried slices are dropped into oil at a temperature of 160-180°C and stirred with narrow wooden stick. When the chips transform to a light yellow colour, they are drained from the fry pan. At around 170°C, the required frying time is around 10 minutes.

To resolve the problems due to high oil content leading to the immediate rancidity and the health problems due to the carcinogens produced during frying, vacuum frying can be adopted. In vacuum frying, the frying happens at temperatures below 100°C. The advantage of vacuum frying is that the oil quality gets maintained and the oil can be reused more than 50 times. It results in high quality products, effectively cutting out oxygen-oil reaction at high temperatures which takes place during normal frying under atmospheric pressure conditions.

After frying, the jackfruit chips can be centrifuged at atmospheric pressure in a separate machine, to remove the excess oil.

### **h. Salting & packing**

The prepared chips are mixed with salt and spices in a mixer. The mixture of salt and dry chilli powder at the ratio of 2:1 @ 8 gm/100 gm is usually added to the fried chips. After salting and spicing, the chips can be packed and stored.



## CHAPTER 3

### MODEL JACKFRUIT CHIPS PROCESSING UNIT UNDER PM-FME SCHEME

#### 3.1 Introduction

The Central Sector scheme for Formalization of Micro Enterprises in Food Processing sector under Ministry of Food Processing Industries, Government of India is an important scheme that offers for formalization and mainstreaming the unorganized home based or micro food processing units. The scheme is useful for expansion of the existing units in terms of capacity and technology through installation of new machineries and additional civil infrastructures. Further, the scheme promotes establishment of new micro units on the principle of ODOP (One District One Product).

Establishment or expansion of Jackfruit chips Processing Unit is an attractive option in potential Jackfruit growing states in India as Jackfruit is a major cash crop cultivated across India. A model generalized DPR is therefore, prepared for expansion of existing unformalized Jackfruit chips Processing Unit. A detailed account of the model DPR prepared on the basis of certain generalized assumptions is discussed in the sequent sections. An entrepreneur can use this model DPR template and modify according to his/her need in terms of capacity, location, raw materials availability etc.

#### 3.2 Form of the Business Enterprise

The entrepreneur concerned must specify about the form of his/her business organization i.e. whether Sole Proprietorship, Cooperative, FPO/FPC, SHG Federation, Partnership Firm or Company and accordingly attach all the required documents. The documents may be registration certificate, share holding pattern, loan approval certificate etc as specified in the FME scheme guidelines.

#### 3.3 Background of the Promoters/ Owners and Required Documents

The detailed bio-data of promoter/promoters inter-alia name, fathers name, age, qualification, business experience, training obtained, contact number, email, office address, permanent address, share holding pattern, definite sources of meeting the commitment of promoters contribution, details of others business along with certified balance sheet and profit loss account for the last 3- 4 years, tax registration, PAN

Number, income tax return etc for 3-4 years and other requirements as specified in the FME guidelines must be provided with the DPR.

### **3.4 Background of the Proposed Project**

The entrepreneur must specify whether it is a new project or expansion of the existing project. If new project is proposed then the reason to go in to the project and if expansion of the existing project, the must specify what kind of expansion is proposed in terms of capacity, product, machines, civil infrastructure etc.

### **3.5 Location of the Proposed Project and Land**

The entrepreneur must provide description of the proposed location, site of the project, distance from the targeted local and distant markets; and the reasons/advantages thereof i.e. in terms of raw materials availability, market accessibility, logistics support, basic infrastructure availability etc. The entrepreneur must mention whether project is proposed in self owned land or rented/allotted land in any industrial park or private location. Accordingly, he/she must provide ownership document, allotment letter/ lease deed.

Land clearance certificate must be from village authority/ municipality or any other concerned authority. The ideal locations for establishment of exclusive Jackfruit chips Processing Units are in the production clusters of the major Jackfruit growing states such as Andhra Pradesh, Telengana, Karnataka, Tamil Nadu, Punjab, Bihar, Gujarat, Haryana, Maharashtra, Madhya Pradesh, Orissa, Uttar Pradesh and Uttarakhand where adequate quantities of surplus Jackfruit will be available for processing.

### **3.6 Installed Capacity**

The maximum installed capacity of the Jackfruit chips Processing Unit in the present model project is proposed as 100 tonnes/ annum. The unit is assumed to operate 300 days/annum @ 8-10 hrs/day. The 1<sup>st</sup> year is assumed to be construction/expansion period of the project; and in the 2<sup>nd</sup> year 70 percent capacity, 3<sup>rd</sup> year 80 percent capacity and 4<sup>th</sup> year onwards 90 percent capacity utilization is assumed in this model project.

### **3.7 Raw Material Requirements for the Unit**

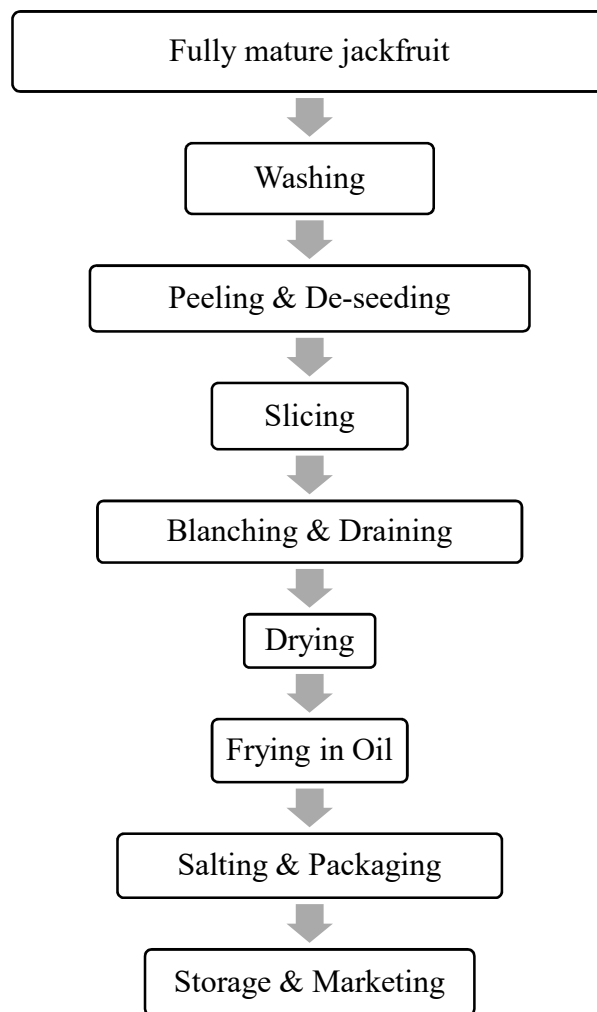
A sustainable food processing unit must ensure maximum capacity utilization and thus requires an operation of minimum 280-300 days per year to get reasonable profit. Therefore, ensuring uninterrupted raw materials supply requires maintenance of adequate raw material inventory. The processor must have linkage with producer organizations preferably FPCs through legal contract to get adequate quantity and quality of raw materials which otherwise get deteriorated. In the current model Jackfruit chips processing project, the unit requires 2.3 Tonnes/ day, 2.7 Tonnes/ day and 3.0 Tonnes/ day of Jackfruit at 70, 80 and 90 percent capacity utilization, respectively.

### **3.8 Product Profile of the Unit**

In the present model Jackfruit chips processing unit, the targeted product output is taken as Jackfruit chips. Jack fruit has great potential for value addition for minimizing post-harvest losses and enhancing the non seasonal availability. Fried snacks have a huge market due to the urbanization and increased disposable incomes. Chips are the most popular snack item in many fast food outlets and jackfruit chips has the scope to be easily marketable in the snack food market.

The NHB has recorded the total jackfruit production in India to be around 2.04 million tonnes during 2015. Out of this a significant portion goes waste because of its highly perishable nature and seasonal glut. The post harvest losses in jackfruit are around 30-35 per cent during the peak season. The quick ripening of the jackfruit after maturity and the subsequent spoilage prompt the need for processing the fruit into easily marketable and long shelf life products. Therefore, jack fruit has great potential for value addition for minimizing post-harvest losses and enhancing the non seasonal availability.

### 3.9 Manufacturing Process of Jackfruit chips



### 3.10 Technology Accessibility

IIFPT and its liaison offices at Guwahati and Bhatinda have all the technical knowhow on Jackfruit chips processing. These technologies are available through training, incubation and consultancy. The entrepreneur can first avail training or consultancy and then undergo business incubation before venturing into the business. Other than IIFPT, NIFTEM, CFTRI and other institutes also have the technical knowledge and training facilities.

### 3.11 Market Demand and Supply

The Indian snack foods market has shown remarkable growth in the past couple of years. The market is forecast to grow with a CAGR of more than 9% in the near future. Major factors driving the global demand of snack foods are growing urbanisation, the rise in disposable incomes and rapidly changing lifestyles.

A busy lifestyle coupled with long working hours have forced people to shift from elaborate luncheons and meals to desk snacks and packaged foods. Snack companies are branching out from original recipes and launching line extensions that deliver interesting ingredients, flavours, and textures to consumers looking for new experiences or alternative ingredients for health reasons.

Value addition to a commodity with a view to provide health and wellness to its consumers is now becoming a priority. Vacuum fried snacks are also gaining significance with all its advantages. Present day consumer's preference for fat-free and low-fat products has been the driving force for the food processing industry to produce lower oil content products that still retain the desirable texture and flavor. Given this trend and the current inclination of people for traditional fried snack products, jackfruit chips processing has immense growth potential market both in national & international market.

### **3.12 Marketing Strategy**

The increasing urbanization offers huge market for readily available Jackfruit chips packaged attractively and merchandised in organized urban platforms such as departmental stores, malls, super markets. Direct marketing kiosks can also be utilised in urban market areas.

The producer may also enter into agreements for supplying to big players or retailers in their brand name or as private labels.

Export market is a major avenue for Jackfruit chips, provided good hygienic production and compliant attractive packaging.

Further there are several e-commerce companies that sell good quality produce, which can be utilized.

### **3.13 Detailed Project Assumptions**

This model DPR for Jackfruit chips Processing Unit is basically prepared as a template based on certain assumptions that may vary with capacity, location, raw materials availability etc. An entrepreneur can use this model DPR format and modify as per requirement and suitability. The assumptions made in preparation of this particular DPR are given in Table 5.

This DPR assumes expansion of existing unit by adding new Jackfruit chips line. Therefore, land and civil infrastructures are assumed as already available with the entrepreneur.

**Table 7: Detailed Project Assumptions**

Parameter	Value	
Assumed Capacity of the Jackfruit chips processing unit :	100 MT/ annum	
Utilization of capacity :	Year 1	Implementation
	Year 2	70%
	Year 3	80%
	Year 4 onwards	90%
Working days per year:	300 days	
Working hours per day:	8-10 hours	
Interest on term loan	12.00%	
Interest on working capital loan	10.00%	
Repayment period	Seven years with one year grace period is considered.	
Average price of raw material:	Rs. 20/ kg	
Average sale price of product	Rs. 300/ kg	

### 3.14 Fixed Capital Investment

#### 3.14. A. Land & Building

This DPR is for FME scheme to upgrade/ formalize existing micro enterprises which already has land & built-up area. However, they can invest to expand the built-up area (Table 5) as required.

**Table 8: Land and Civil Infrastructures**

i. Land 1000 Sq ft	Assumed land already developed and has 6000 sq ft built in area. So additional 1000 sq ft can be built in @ Rs. 200/sq ft Rs. 2.00 Lakhs
ii. Built-up processing area 6000 sq ft	
iii. Storage area 1000 sq ft	
Total	Rs. 2.00 Lakhs

### 3.14. B. Machinery & Equipment: Rs. 20.00 Lakhs

<b>Table 9: Machineries &amp; Equipments</b>						
<b>S.No</b>	<b>Description</b>	<b>Power required</b>	<b>Area reqd (Sq.ft)</b>	<b>Unit Price, (Rs. in lakhs)</b>	<b>Qty</b>	<b>Amount (Rs. in lakhs)</b>
1.	Peeler	2 HP	50	0.25	2	0.50
2.	Bulb remover	2 HP	50	0.25	2	0.50
3.	Slicer	2 HP	50	0.5	2	1.00
4.	Blancher cum Dryer	2 HP	200	2.00	1	2.00
5.	Vacuum Fryer	12 HP	300	10.00	1	10.00
6.	Fryer	2 HP	100	1.00	1	1.00
7.	Packing machine	2 HP	50	2.00	1	2.00
8.	Boiler Steam output 10 kg Working pressure 10 bar max	2 HP	100	3.00	1	3.00
	<b>Total</b>					<b>20.00</b>

### 3.14. C. Utilities and Fittings

<b>Table 10: Utilities and Fittings</b>	
Power	Rs. 1.20 Lakhs
Water	Rs. 0.8 Lakhs
Total	Rs. 2.00 lakhs

### 3.14. D. Other Fixed Assets

<b>Table 11: Other Fixed Assets</b>	
Furniture and fixtures	Rs. 2.00 Lakh
Utensils, trays, thermometer, refractometer, etc	
Total	Rs. 2.00 Lakh

### 3.14. E. Pre-operative Expenses

Table 12: Pre-operative Expenses	
Legal expenses, start-up expenses, establishment cost, consultancy fee, trial runs, & others	Rs. 25,000.00
Total Pre-operative Expenses	Rs. 25,000.00

### 3.14. F. Total Fixed Capital Investment

Total Fixed Capital Investment = (Land & Building + Machinery & Equipment+ Utilities and Fittings + Other Fixed Assets + Pre-operative Expenses)

= Rs. (2+20.00+2+2+0.25) Lakhs = **Rs. 26.25 Lakhs**

### 3.15. Working Capital Requirement

Table 13: Working Capital Requirement (Rs. in Lakh)				
Particulars	Period	year 2 (70% - 70 MT)	year 3 (80% - 80 MT)	year 4 (90% - 90 MT)
Raw material stock	7 days	2.92	3.33	3.75
Packing material	15 days	1.28	1.46	1.65
Work in progress	15 days	7.46	8.76	9.82
Finished goods' stock	15 days	7.16	8.70	9.78
Receivables	30 days	16.73	20.64	23.24
Total current assets		35.55	42.89	48.24
Trade creditors		0	0	0
Working capital gap		35.55	42.89	48.24
Margin money (25%)		8.89	10.72	12.06
Bank finance		26.66	32.17	36.18



### 3.16. Total Project Cost and Means of Finance

<b>Table 14: Total Project Cost and Means of Finance (Rs. in Lakhs)</b>	
<b>Particulars</b>	<b>Amount</b>
i. Land and building	2.00
ii. Machinery and equipments	20.00
iii. Utilities & Fittings	2.00
iv. Miscellaneous Fixed assets	2.00
v. Pre-operative expenses	0.25
vi. Contingencies	2.00
vii. Working capital margin	8.89
<b>Total project cost (i to vii)</b>	<b>37.14</b>
<b>Means of finance</b>	
i. Subsidy	10.00
ii. Promoter's contribution	13.14
iii. Term loan	14.00

### 3.17. Manpower Requirement

<b>Table 15: Manpower Requirement</b>			
<b>Particulars</b>	<b>No. of persons</b>	<b>Monthly Wage (Rs.)</b>	<b>Total Monthly Salary (Rs.)</b>
i. Manager (can be the owner )	1	20000	20000
ii. Skilled worker	2	10000	20000
iii. Semi skilled	3	7500	22500
iv. Helper	3	5000	15000
v. Salesman	1	7500	7500
<b>Total</b>	<b>10</b>		<b>85000</b>

Note: Only the manager and two skilled workers are permanent staffs (Salary Rs. 40000/ month). Others are causal staffs.

## 3.18. Expenditure, Revenue and Profitability Analysis

Table 16: Expenditure, Revenue and Profitability Analysis									
	Particulars	1 <sup>st</sup> year	2 <sup>nd</sup> year	3 <sup>rd</sup> year	4 <sup>th</sup> year	5 <sup>th</sup> year	6 <sup>th</sup> year	7 <sup>th</sup> year	8 <sup>th</sup> year
A	<b>Total Installed Capacity</b>	120 MT/Year Jackfruit chips							
	Capacity utilization (%)	Under const. (0%)	70 MT (70%)	80 MT (80%)	90 MT (90%)	90 MT (90%)	90 MT (90%)	90 MT (90%)	90 MT (90%)
B	<b>Expenditure (Rs. in Lakh)</b>								
	Jackfruit (Av. Price @ Rs. 20/ Kg )	0.00	140.00	160.00	180.00	180.00	180.00	180.00	180.00
	Packaging materials @ Rs. 10/ Unit	0.00	30.71	35.10	39.48	39.48	39.48	39.48	39.48
	Utilities (Electricity, Fuel)	0.00	4.04	4.43	4.82	4.82	4.82	4.82	4.82
	Salaries (1st yr only manager's salary)	2.40	7.91	8.67	9.44	9.44	9.44	9.44	9.44
	Repair & maintenance	0.00	0.69	0.69	0.69	0.69	0.69	0.69	0.69
	Insurance	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Miscellaneous expenses	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	<b>Total Expenditure</b>	3.20	184.15	209.69	235.23	235.23	235.23	235.23	235.23
C	<b>Total Sales Revenue (Rs. in Lakh)</b>								
	Sale of Jackfruit chips @ Rs. 80/ kg	0.00	200.71	247.63	278.91	281.52	281.52	281.52	281.52
D	<b>PBDIT (Total Sales Revenue-Total Expenditure) (Rs. in Lakh)</b>	-3.20	16.56	37.94	43.68	46.29	46.29	46.29	46.29
	Depreciation on civil works @ 5% per annum	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07

	Depreciation on machinery @ 10% p.a	2.02	1.82	1.64	1.47	1.32	1.19	1.07	0.97
	Depreciation on other fixed assets@ 15% p.a	0.91	0.77	0.65	0.56	0.47	0.40	0.34	0.29
	Interest on term loan @ 12% p.a	1.67	1.67	1.49	1.20	0.92	0.64	0.36	0.09
	Interest on working capital @ 10% p.a	0.00	2.67	3.22	3.62	3.64	3.64	3.64	3.64
E	<b>Profit after Depreciation and Interest</b> (Rs. in Lakh)	-7.90	9.53	30.85	36.74	39.86	40.34	40.81	41.23
F	Tax (assumed 15%) (Rs. in Lakh)	0.00	2.19	3.27	3.82	3.97	4.03	4.10	4.17
G	<b>Profit after depreciation, Interest &amp; Tax</b> (Rs. in Lakh)	-7.90	7.34	27.58	32.92	35.89	36.31	36.71	37.06
H	Surplus available for repayment (PBDIT- Interest on Working Capital -Tax) (Rs. in Lakh)	-3.20	11.70	31.45	36.24	38.68	38.62	38.55	38.48
I	Coverage available (Rs. in Lakh)	-3.20	11.70	31.45	36.24	38.68	38.62	38.55	38.48
J	Total Debt Outgo (Rs. in Lakh)	1.67	3.67	3.49	3.20	2.92	2.64	2.36	2.09
K	<b>Debt Service Coverage Ratio (DSCR)</b>	-1.92	3.19	9.01	11.33	13.25	14.63	16.33	18.41
	<b>Average DSCR</b>	10.53							
L	<b>Cash accruals (PBDIT- Interest-Tax)</b> (Rs. in Lakh)	-4.87	12.70	33.18	38.66	41.40	41.62	41.83	42.03
M	<b>Payback Period</b> (on Rs. 37 Lakhs initial investment)	3 years							

### 3.19. Repayment Schedule

Year	Outstanding loan at start of yr.	Disbursement	Total outstanding Loan	Surplus for repayment	Interest payment	Repayment of principal	Total outgo	o/s Loan at the end of the yr.	Balance left
1	0	14	14	-3.20	1.67	0	1.67	14	-4.87
2	14		14	11.70	1.67	2	3.67	12	8.03
3	12		12	31.45	1.49	2	3.49	10	27.96
4	10		10	36.24	1.20	2	3.2	8	33.04
5	8		8	38.68	0.92	2	2.92	6	35.76
6	6		6	38.62	0.64	2	2.64	4	35.98
7	4		4	38.55	0.36	2	2.36	2	36.19
8	2		2	38.48	0.09	2	2.09	0	36.39

### 3.20. Assets' Depreciation

<b>Table 18: Assets' Depreciation (Written Down Value Method) (Rs. in Lakh)</b>								
<b>Particulars</b>	<b>1st Year</b>	<b>2nd Year</b>	<b>3rd Year</b>	<b>4th Year</b>	<b>5th Year</b>	<b>6th Year</b>	<b>7th Year</b>	<b>8th Year</b>
Civil works	2.02	1.92	1.82	1.73	1.64	1.56	1.48	1.41
Depreciation	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07
Depreciated value	1.92	1.82	1.73	1.64	1.56	1.48	1.41	1.34
Plant & Machinery	20.19	18.17	16.35	14.71	13.24	11.92	10.73	9.66
Depreciation	2.02	1.82	1.64	1.47	1.32	1.19	1.07	0.97
Depreciated value	18.17	16.35	14.71	13.24	11.92	10.73	9.66	8.69
Other Fixed Assets	6.04	5.13	4.36	3.71	3.15	2.68	2.28	1.94
Depreciation	0.91	0.77	0.65	0.56	0.47	0.40	0.34	0.29
Depreciated value	5.13	4.36	3.71	3.15	2.68	2.28	1.94	1.65
All Assets	28.25	25.22	22.53	20.15	18.03	16.16	14.49	13.01
Depreciation	3.03	2.69	2.38	2.12	1.87	1.67	1.48	1.33
Depreciated value	25.22	22.53	20.15	18.03	16.16	14.49	13.01	11.68

### 3.21. Financial Assessment of the Project

Table 19: Benefit Cost Ratio (BCR) and Net Present Worth (NPW)										
S. No	Particulars	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	
i	Capital cost (Rs. in Lakh)	28.25	0	0	0	0	0	0	0	
ii	Recurring cost (Rs. in Lakh)	3.20	184.15	209.69	235.23	235.23	235.23	235.23	235.23	
iii	Total cost (Rs. in Lakh)	31.45	184.15	209.69	235.23	235.23	235.23	235.23	235.23	1601.44
iv	Benefit (Rs. in Lakh)	0.00	200.71	247.63	278.91	281.52	281.52	281.52	281.52	
v	Total Depreciated value of all assets (Rs. in Lakh)								11.68	
vi	Total benefits (Rs. in Lakh)	0.00	200.71	247.63	278.91	281.52	281.52	281.52	293.20	1865.01
<b>Benefit-Cost Ratio (BCR): 1.16 (Profitable Project)</b> <b>Net Present Worth (NPW): 263.57</b>										

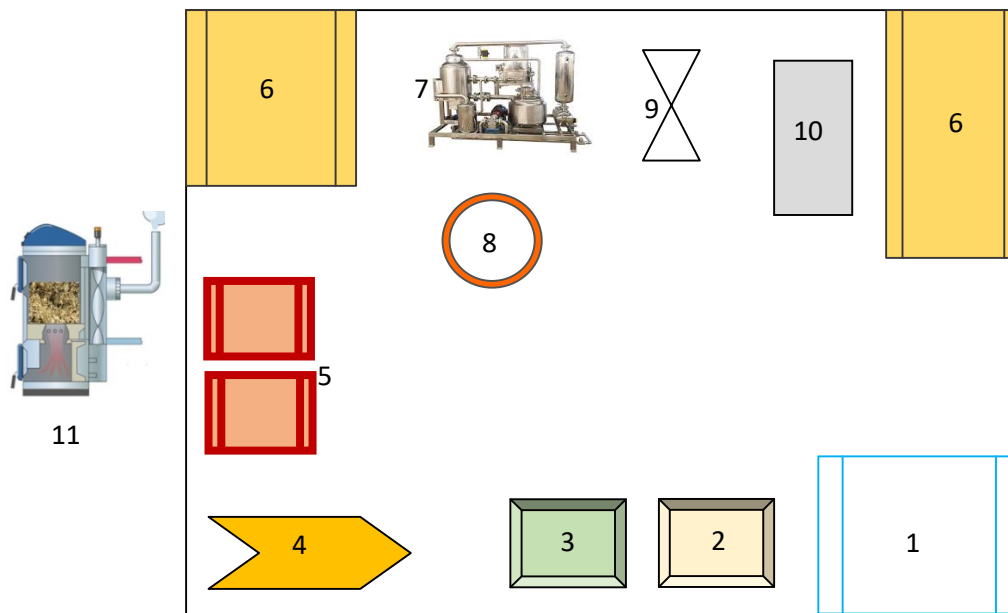
Break Even analysis indicates costs-volume-profit relations in the short run. This is the level at which the firm is in no loss no profit situation.

<b>Table 20: Break-Even Analysis</b>									
<b>S.No</b>	<b>Particulars</b>	<b>1<sup>st</sup> year</b>	<b>2<sup>nd</sup> year</b>	<b>3<sup>rd</sup> year</b>	<b>4<sup>th</sup> year</b>	<b>5<sup>th</sup> year</b>	<b>6<sup>th</sup> year</b>	<b>7<sup>th</sup> year</b>	<b>8<sup>th</sup> year</b>
	Capacity utilization	Under const (0%)	70 MT (70 %)	80 MT (80 %)	90 MT (90 %)	90 MT (90 %)	90 MT (90 %)	90 MT (90 %)	90 MT (90 %)
<b>A</b>	<b>Fixed Cost (Rs. in Lakh)</b>								
	Permanent staff salaries	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55
	Depreciation on building @ 5% p.a	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07
	Depreciation on machinery @ 10% p.a	2.02	1.82	1.64	1.47	1.32	1.19	1.07	0.97
	Depreciation on other fixed assets @ 15% p.a	0.91	0.77	0.65	0.56	0.47	0.40	0.34	0.29
	Interest on term loan 12% p.a	1.67	1.67	1.49	1.20	0.92	0.64	0.36	0.09
	Insurance	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	<b>Total Fixed Cost (Rs. in Lakh)</b>	7.55	7.21	6.72	6.17	5.64	5.16	4.69	4.27
<b>B</b>	<b>Sales Revenue (Rs. in Lakh)</b>	0.00	200.71	247.63	278.91	281.52	281.52	281.52	281.52
<b>C</b>	<b>Variable Cost (Rs. in Lakh)</b>								
	Jackfruit (Average Price @ Rs.3/ kg )	0.00	140.00	160.00	180.00	180.00	180.00	180.00	180.00
	Packaging materials @ Rs.10/ Unit	0.00	30.71	35.10	39.48	39.48	39.48	39.48	39.48
	Casual staff salaries	0.00	5.36	5.36	5.36	5.36	5.36	5.36	5.36

	Utilities (Electricity, Fuel)	0.00	4.04	4.43	4.82	4.82	4.82	4.82	4.82
	Repair & maintenance	0.00	0.69	0.69	0.69	0.69	0.69	0.69	0.69
	Miscellaneous expenses	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Interest on working capital	0.00	2.67	3.22	3.62	3.64	3.64	3.64	3.64
	Total Variable Cost (Rs. in Lakh)	0.50	183.97	209.30	234.47	234.49	234.49	234.49	234.49
D	<b>Break Even Point (BEP) as % of sale</b>	0.00	43.07%	17.53%	13.88%	11.99%	10.97%	9.97%	9.08%
	<b>Break Even Point (BEP) in terms of sales value (Rs. in Lakhs)</b>		86.45	43.41	38.72	33.76	30.89	28.07	25.56



### 3.22 Plant Layout



- |                      |                |
|----------------------|----------------|
| 1 Fruit washing area | 7 Vacuum fryer |
| 2 Peeling area       | 8 Fryer        |
| 3 Bulb removing      | 9 Salting      |
| 4 Slicer             | 10 Packing     |
| 5 Blancher cum Dryer | 11 Boiler      |
| 6 Storage            |                |

### 3.23. Machinery Suppliers

The entrepreneur must provide tentative supplier list and quotations with respect to his project. However, there are many machinery suppliers available within India for Jackfruit chips processing machineries and equipments. Some of the suppliers are:

1. M/s. Batliboi and Company Ltd. P.B. No. 3066, Old Railway Station Road, Kochi-682018.
2. M/s. H and P Industries Near Mundupalam Junction, Thrissur -110006
3. M/s. Raylons Metal Works P.O. Box No. 17426, JB Nagar, Andheri (E), Mumbai - 400059.
4. M/s. Laxmi Boilers 2453-B, Karkmpatta Road, Pallimukku, Cochin-682016.

5. M/s Shri Industry No. 17/141, Gurukrupa, Kolhapur Ichalakaranji - 416115 Maharashtra, India
6. M/s Suan Scientific Instruments & Equipments P-814, Ground Floor, Block A, Lake Town, Kolkata - 700089, West Bengal, India Telephone: +91-33-25342047 Mobile: +91-9903872341/ +91-9433263575.
7. M/s B Sen Barry & Company 65/11, New Rohtak Road, New Delhi-110005, (India). Phone: 91-11-65702298, 65702299, 28720553, 28726429. E-Mail: info@bsenbarry.com
8. Sakthi Automated Food Machines Manufacturing Company, 1/441, Avinashi Road, City Union Bank Building, Near Airport, Chinniyampalayam, Coimbatore - 641062, Tamil Nadu
9. Future Tech Foods India Private Limited No. 11, 202, Phatak Park Apartment, Karve Road, Next To Tech Mahendra Gate, Erandwane, Pune - 411004, Maharashtra, India
10. Dyna Vac Systems Room No.1, Ground Floor, V. I. T. C. Export, Model Bhawan, 4th Phase, Peenya, Bengaluru - 560058, Karnataka, India
11. Snactek Food Machines Private Limited Plot No. 33, Burhani Industrial Estate, Kondhwa Bk Pune - 411048, Maharashtra, India

## CHAPTER 4

### LIMITATIONS OF THE MODEL DPR AND GUIDELINES FOR ENTREPRENEURS

#### 4.1. Limitations of the Model DPR

i. This model DPR has provided only the basic standard components and methodology to be adopted by an entrepreneur while submitting a proposal under the Formalization of Micro Food Processing Enterprises Scheme of MoFPI.

ii. This is a model DPR made to provide general methodological structure not for specific entrepreneur/crops/location. Therefore, information on the entrepreneur, forms and structure (proprietorship/partnership/cooperative/ FPC/joint stock company) of business, background of proposed project, location, raw material base/contract sourcing, entrepreneur's own SWOT analysis, market research, rationale of the project for specific location, community advantage/benefit, employment generation etc are not given in detail.

iii. The present DPR is based on certain assumptions on cost, prices, interest, capacity utilization, output recovery rate and so on. However, these assumptions in reality may vary across places, markets and situations; thus the resultant calculations will also change accordingly.

iv. This particular DPR is made on three components of means of finance i.e. grant, owner's contribution and loan/debt as followed in many central sector schemes.

#### 4.2. Guidelines for the Entrepreneurs

i. The success of any prospective food processing project depends on how closer the assumptions made in the initial stage are with the reality of the targeted market/place/situation. Therefore, the entrepreneurs must do its homework as realistic as possible on the assumed parameters.

ii. This model DPR must be made more comprehensive by the entrepreneur by including information on the entrepreneur, forms and structure (proprietorship/partnership/cooperative/ FPC/joint stock company) of entrepreneur's business, project location, raw material base/contract sourcing, entrepreneurs own SWOT analysis, detailed market research, comprehensive product mix based on demand, rationale of the project for specific location, community advantage/benefit

from the project, employment generation, production/availability of the raw materials/crops in the targeted area/clusters and many more relevant aspects for acceptance and approval of the competent authority.

iii. The entrepreneur must be efficient in managing the strategic, financial, operational, material and marketing aspects of a business. In spite of the assumed parameter being closely realistic, a project may become unsustainable if the entrepreneur does not possess the required efficiency in managing different aspects of the business and respond effectively in changing situations.

iv. The machineries should be purchased after thorough market research and satisfactory demonstration.

v. The entrepreneur must ensure uninterrupted quality raw materials' supply and maintain optimum inventory levels for smooth operations management.

vi. The entrepreneur must possess a strategic look to steer the business in upward trajectory.

vii. The entrepreneur must maintain optimum (not more or less) inventory, current assets. Selecting optimum source of finance, not too high debt-equity ratio, proper capital budgeting and judicious utilization of surplus profit for expansion is must.

viii. The entrepreneur must explore prospective markets through extensive research, find innovative marketing strategy, and maintain quality, adjust product mix to demand.

ix. The entrepreneur must provide required documents on land, financial transaction, balance sheet, further project analysis as required by the competent authority for approval.

x. The entrepreneur must be hopeful and remain positive in attitude.



## Contact Us

### Director

## Indian Institute of Food Processing Technology

(Ministry of Food Processing Industries, Government of India)

Pudukkottai Road, Thanjavur - 613 005, Tamil Nadu

Phone No.: +91- 4362 - 228155, Fax No.:+91 - 4362 - 227971

Email: [director@iifpt.edu.in](mailto:director@iifpt.edu.in); Web: [www.iifpt.edu.in](http://www.iifpt.edu.in)

